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ScienceDirect

Procedia Computer Science 60 (2015) 1240 – 1246

Procedia Computer Science

19th International Conference on Knowledge Based and Intelligent Information and Engineering Systems

Development of a method for visualization of skills at experiments and practical training

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Abstract

It's lacking the indexes of evaluation to the experiments which are the advantage of National Institute of Technology, Japan (in the following, NIT). The features of NIT will be appearing that we make it clearly attainment targets and the indexes of evaluation. Then we can expect the effects of the feeling of achievement and the will because of visualizing student's skill by the indexes of evaluation. Moreover, it will be able to improve the education of utilizing the Skill-Sheet. We proposed the introduction method of evaluation to the experiments.

Keywords: Skill-Sheet, evaluation, experimental skill, Skill-Sheet for visualization, Model Core Curriculum

1. Introduction

National Institute of Technology which exists in the whole country 51 schools (in the following, NIT) is carrying out consistency or 7 year consistent education system for 5 years. It can be said that it's also a unique education system in engineering education in Japan.10,856 people graduate in fiscal year 2013 as an example, and 9444 people of 87% have got a job. The graduate of NIT often participates in a practice site of factory duties and a practical

doi:10.1016/j.procs.2015.08.239

business affair superintendent. Practicing technical power at a workplace is desired. The various experiment description which had education of practicing technical power for its object is set as a curriculum.

The common department isn't set and is different in the number of departments in 51 NIT. Even if a department of the same field exists, the experimental guide is sometimes different in the grade which makes an experiment in NIT. NIT is the school which originated in an area, and the surrounding enterprise is given by one establishing the curriculum which considered asked technology because to a student. Up to now, it has been put into effect for the skill acquisition an area enterprise and each technical college desire about experiment method and evaluation method. An index was established according to the technical college to estimate practicing technical power in the student who expects practicing technical power.

Education contents of each technical college will be an attainment target in practicing technical power education clearly by specifying the evaluation index, and a possibility that the feature which wasn't being seen up to now is appearing is considered. It's possible to visualize student's skill by clarifying the evaluation index. And more practicing will for the technical power education and feeling of achievement of the student can expect the effect which rises. And you can expect to be linked by utilization of the Skill-Sheet to educational improvement of education of the field crossing ability as well as an experimental training.

There is an educational effect by the evaluation introduction of an experimental skill. Firstly, the feature of the education contents is clarified. An arrival target and the evaluation index to an experiment of each NIT are gathered systematically. As a result, education contents and the feature become clear. Secondly, it visualize student's experimental skills. It made 5 evaluation standard which was elements of experimental and basis, theory, measurement, analysis, report. The evaluation which is an experimental skill using this evaluation standard. As a result, it can be expected that the achievement is visualized smaller, and the feeling of achievement of the student and the will is risen. A teacher would be able to guide a student more tenderheartedly. Lastly, it is educational improvement. It would be linked to reconsideration of a curriculum and educational improvement by using the Skill-Sheet.

2. Model Core Curriculum

NIT is to clarify the practical and creative engineers' image and policy for the way of education content and method therefor trying to train, we play an accountability to society. Then, each college of NIT is to further promote the reform and improvement of education, to ensure the quality of education.

Model Core Curriculum[1] has been proposed from the above background, it consists of two of the following contents. One is "core (minimum standard)": minimum capacity levels and acquire content that aims to reach the all the students of the NIT, and another is "model": guidelines in order to further the advancement of technical college education in response to the more advanced social demands. Therefore, we are using the name of "model core curriculum". For "model" part, a leading Efforts shared by all colleges of NIT, we will introduce in accordance with the actual circumstances of each college.

Model Core Curriculum is not intended to indicate a specific curriculum for schools to organize and implement, it is intended to present the goals (outcomes) should make wearing the student as a guide for curriculum organization. This idea, we believe that along the direction that is emphasized in international to domestic as well.

3. Making procedure of the Skill-Sheet

We proposed the Skill-Sheet for visualization of the skill of student's engineering experiments[2][3][4]. This sheet will be use to evaluate of experiments of Electric engineering field of Model Core Curriculum. It's utilized as the common value in NIT. We approached visualization of an experimental skill by 4 items[5]. This 4 items mean "Use equipment and devices", "The theory which became experimental background", "The data of experiments (data)", "arrangement and consideration target of experimental results (keywords)".

First we collected experimental guidance notes from corporate of some college of NIT. It show the Fig.1. The experimental guidance notes included special contents which depend on the device, environment and so on. Second, we classified those by experiment description. It show the Fig.2. Finally, we picked out the keyword which are 4

kinds of items. It show the Fig.3 and Fig4. The line means Use equipment and devices , the magenta line cyan is the theory , the data line is the data of experiments and the orange line is arrangement and consideration target of experimental results. These keyword collected the skill-sheet of 4 kinds of items. This sheet was made an experimental Skill-Sheet.

Next, level setting of experiment description was performed. Standard Skill-Sheet was made from the experimental Skill-Sheet relevant to this experiment description. Skill evaluation sheet was made from this standard Skill-Sheet. We were performed Level setting to a key word in the item at evaluation Skill-Sheet.

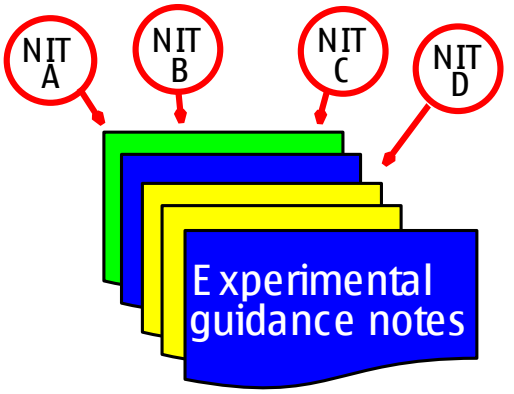

Fig.1. experimental guidance notes

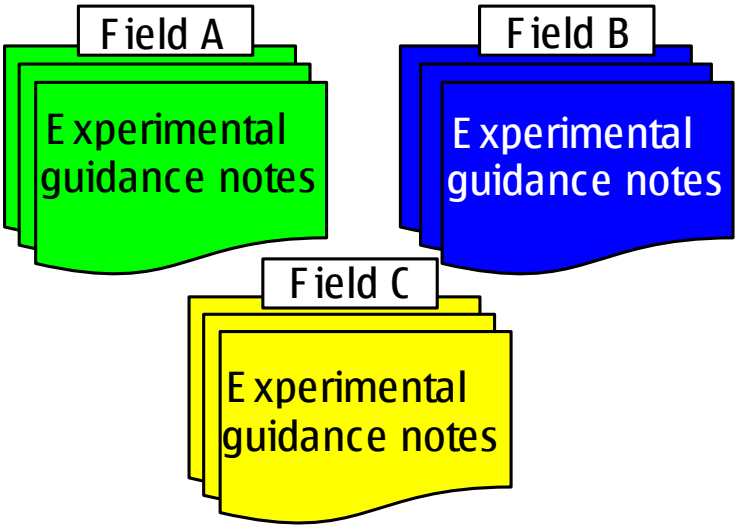

Fig.2. The classification of experiment description

keyword extraction
magenta : Equipment and Device
cyan : Theory and Background
green : Data
orange : Arrangement and Consideration

6 ［3,4,5日目］回路製作

シミュレーション結果を基に，実際

6.1 ［3日目］設計した回路の

差動増幅器は対になる素子の特性が近似 ため，使用する各抵抗値をテスタで測定し決定する．同様な理由から，トランジスタや抵抗の足を利用して回路中の無駄な配線を減らすよう注意すること．

入力電圧に0［V］（GND）を入力した後，各接点での電位を測定し，設計値からのずれを確認せよ．また，半固定抵抗の出力への影響を確認せよ．

6.2 ［3日目］増幅利得の周波数特性測定

入力電圧波形と出力電圧波形のpeak-to-peak値をから電圧利得を算出する．出力波形が歪まないよう入力電圧の振幅を調整する[5]．

Fig.3. The keyword extraction 1

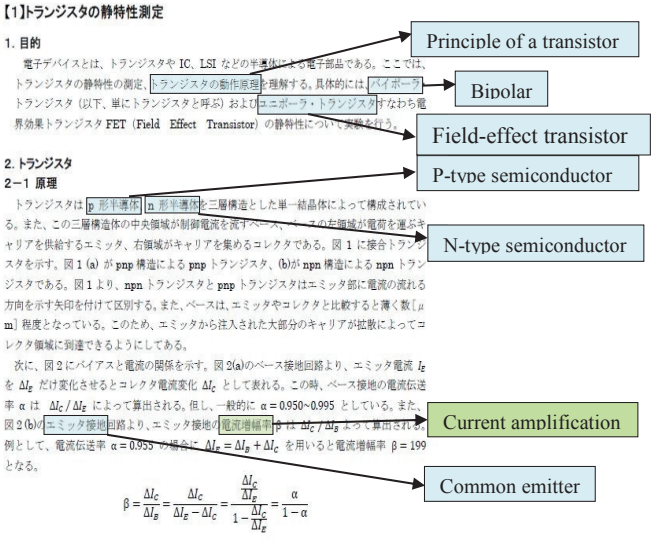

Fig.4. The keyword extraction 2

4. Case of electric systems

We explain the process of the Skill-Sheets of the electric electronic system field of Model Core Curriculum.

First we collected experimental guidance notes for 237 cases from 4 NIT by electric system. We choose experimental themes of isoelectric line, direct-current circuit and alternating-current circuit. The experimental guidance notes which of were included those experimental themes were 47. We decided the experimental levels which were used to evaluate of experiments of Electric Electronic engineering field of Model Core Curriculum. We analyzed experiment guide notes which based on Model Core Curriculum. As a results, electronics fundamental experiments themes are 4, direct current circuit theme are 17 and alternating current circuit themes are 26.The themes example of those notes which are used by second grader students and third grader students are shown in the Table.1.

Second, we classified the experimental level using the evaluation of Model Core Curriculum. It show the Table.2. The experimental level 1 was made the basic theme which is the special quality only of R, L and C device. The experimental level 2 was made the developed theme which is the special quality of RC and RL. The experimental level 3 was made experimental themes of the theory which are a RLC circuit network and inductive coupled circuit and experimental themes of the contents which aren't on MCC, etc. We analyzed experiment guide notes which the experimental level 1 were 8, the experimental level 2 were 21 and the experimental level 3 were 6.

Third, we made the standard Skill-Sheet to the contents of alternating-current circuit. This sheet will be able to evaluate of experiments of Electric engineering field of Model Core Curriculum and common skills in NIT. The standard Skill-Sheet consists level 1 to level 3. It show the Table.3. Level 1 is the how to use the oscilloscope and the RLC device element. Level 2 is AC bridge circuit, the RLC combination integrated circuit, the contents of a resonant circuit and alternating-current power. Level 3 is a transition phenomenon of passive circuit, an LC passive filter and experimental of high theory. And the standard Skill-Sheet was made using general terminology.

Finally, we made the experimental evaluation Skill-Sheet using the standard Skill-Sheet. It show the Table.4. We made this sheet of 5 stage evaluation. As a result, students will are able to estimate a useful skill of a basic measuring instrument in every grade. This instrument was made a voltmeter, an ammeter, a wattmeter and an oscilloscope.

Table 1. The themes example of experimental guidance notes .

	A-NCT	B-NCT	C-NCT	D-NCT
2nd grade	1. Measurement of the voltage, an electric current and resistance 2. Directions of analog / digital oscilloscope 3. RCL circuit characteristic	1. Rectification property of a diode 2. Waveform observation using an oscilloscope 3. Electrostatic field by a mapping	1. How to use the oscilloscope 2. Wheatstone bridge circuit 3. RC series circuit and oscilloscope	1. Measurement of isoelectric line 2. Kirchhoff's principle 3. AC bridge circuit
3nd grade	1. Isoelectric line 2. Measurement of L and C 3. Resonance of alternating-current circuit	1. Experiment of alternating-current circuit 2. Frequency characteristics measurement of a RC circuit 3. Impedance characteristic measurement of resonant circuit	1. Waveform observation using an oscilloscope 2. Experiment of electric circuit 3. Experiment on contotrol using PIC	1. LC resonance circuit 2. Measurement of impedance 3. Transient phenomena of electric circuit

Table 2. Experimental theme according to the level.

	Experimental guidance
L1	Directions of analog / digital oscilloscope. Waveform observation using an oscilloscope. How to use the oscilloscope.
L2	Measurement of L and C. Resonance of alternating-current circuit. Experiment of alternating-current circuit. Frequency characteristics measurement of a RC circuit. Impedance characteristic measurement of resonant circuit. Waveform observation using oscilloscope. Experiment of electric circuit. RC series circuit and oscilloscope. AC bridge circuit. LC resonance circuit. Measurement of impedance.
L3	Transient phenomena of electric circuit.

Table 3. The standard Skill-Sheet according to the level.

L1	Waveform observation using an oscilloscope. characteristics measurement of R, L and C.
L2	AC bridge circuit. Circuit characteristic measurement of RLC combination. Resonance circuit. AC power.
L3	Transient phenomena of passive circuit. LC passive filter.

Table 4. 5 stages of evaluation Skill-Sheet example.

	item	1th grade	2th grade	3th grade	4th grade	5th grade
voltmeter	Wire and measure right.					
	Estimate the measurement accuracy.					
	Consider internal resistance.					
	Consider frequency response.					
oscilloscope	Waveform measurements right.					
	Measure 2 phenomena of corrugation.					
	Proofreading of a probe.					

5. Conclusion

We proposed an arrival target in an experiment of NIT and the way to specify the evaluation index. Experimental Skill-Sheet and standard Skill-Sheet can understand experiment description for students. Evaluation Skill-Sheet can grasp the utilization power of the measuring instrument, one's own advantage and weak point. After it was compared with other NIT by experimental Skill-Sheet and standard Skill-Sheet, teachers can do experimental improvement, development and equipment substantiality. Grasp and education technique improvement of the measuring instrument utilization power of the student are made of evaluation Skill-Sheet. An enterprise depends on experimental Skill-Sheet and standard Skill-Sheet, and, NIT, experiment description common between the personal experiment

description and NIT can be grasped. The measuring instrument utilization power of the student can be grasped at the evaluation Skill-Sheet.

In the future, We would like to apply to one of these Skill-Sheet for 5 colleges this academic year, Tsuruoka, Sendai, Miyakonojo, Oyama, Hakodate.We will report this results next paper.

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